


# MEDICINE STORING AND DISPENSING APPARATUS

## BACKGROUND OF THE INVENTION

### 1. Technical Field

[0001] The present invention relates to a medicine storing and dispensing apparatus having a function allowing automatic mounting of a cap on an upper opening of a vial bottle.

### 2. Description of the Related Art

[0002] Conventionally, vial bottles are closed by caps after medicine is stored therein (see, e.g., United States Patent No. 5,502,944 and United States Patent No. 5,208,762).

[0003] Apparatuses for feeding caps to containers include those structured to be able to feed caps one by one while applying vibration by a vibrator so that all the caps are orientated in the same direction and to change the direction of the caps by a posture control means so that the caps face the same direction (see, e.g., Japanese unexamined patent application No. H07-251915) and those structured to rotate a scraping disc plate provided aslant so as to utilize a stepped shape formed in an outer circumferential section of a center wheel (see, e.g., Japanese unexamined patent application No. 2002-179004).

[0004]

SUMMARY OF THE INVENTION

[0005] However, in United States Patent No. 5,502,944, the structure for automatically feeding caps to the vial bottles is not disclosed, while in United States Patent No. 5,208,762, the particular structure therefor is not disclosed either. In the Japanese unexamined patent application no. H07-251915, the cap feeding section requires the vibrator and the posture control means, which causes problems such as high costs and complicated structure. Further, in the Japanese unexamined patent application no. 2002-179004, there is a problem in that a cap storable region is limited in order to accomplish appropriate direction change of the caps by the center wheel.

[0006] It is a primary object of the present invention to provide a medicine storing and dispensing apparatus that is capable of feeding caps all in the state of being oriented in the same direction to medicine containers by a simple and inexpensive structure.

[0007] As a means to solve the problem, there is provided, in the present invention, a medicine storing and dispensing apparatus comprising a cap feeding section. The cap feeding section includes:

a cap container storing a plurality of caps for

closing openings of medicine containers and having a slit formed at least one location of a bottom surface of the cap container;

a cap stirring member which has at least one stirring section formed in a rotating shaft in the state of protruding inside the cap container through the slit and which stirs the caps by the stirring section through rotational driving; and

a cap pathway which continues to the cap container, has a clearance allowing only one cap to pass through and which is inclined downward so as to align the passing caps.

[0008] With this structure, once the cap stirring member is driven, the caps in the cap container are stirred by the stirring section and go one by one in sequence into the cap pathway through the clearance so as to be aligned.

[0009] It is preferable that the cap container have an inclined surface that is inclined toward the rotating shaft of the cap stirring member. The inclined surface having each slit formed thereon, because it becomes easy to gather the stirred caps toward the clearance continuing to the cap pathway along the inclined surface.

[0010] It is preferable that the cap stirring member be structured so that the stirring section has a plurality of protruding sections placed on an outer circumferential

section of the rotating shaft for allowing stirring of the caps toward the inclined surface through rotational driving, because it becomes possible to smoothly feed the caps to the cap pathway while preventing a cap jam in a vicinity of the clearance toward the cap pathway.

[0011] It is preferable that the cap stirring member be structured so that the stirring section has a plurality of protruding sections placed in a spiral manner on an outer circumferential section of the rotating shaft for allowing movement of the caps from one end side to the other end side of the rotating shaft through rotational driving and that the cap pathway be placed on the other end side of the rotating shaft, because each stirring member can guide the caps to the clearance toward the cap pathway only with rotational driving of the cap stirring member, which further allows smooth feeding of the caps to the cap pathway.

[0012] It is preferable that the cap stirring member be placed in a plurality of locations, because it becomes possible to further prevent a cap jam in the vicinity of the clearance toward the cap pathway and to smoothly move the caps to the cap pathway.

[0013] It is preferable that the cap pathway include:

an inclined support section for supporting incoming caps by engaging with inner recess sections of the

moving caps so as to further incline the inner recess sections in a case where the passing caps are positioned with the inner recess sections thereof being oriented downward;

a cap detecting section for detecting the caps supported in an inclined state by the inclined support section;

an extruding means for moving the caps by canceling an engaged state of the caps supported by the inclined support section based on a detection result by the cap detecting section; and

a cap direction changing section for changing a direction of the caps based on the detection result by the cap detecting section so as to orient the inner recess sections in an identical direction, because it becomes possible to align the inner recess sections of the caps in an identical direction with a simple and inexpensive structure.

[0014] It is preferable that the cap pathway have a pair of chute rails placed at an interval smaller than an inner diameter of the inner recess sections of the caps and that the inclined support section be formed by cutting away a part of the chute rails, because it becomes possible to credibly support the caps, which are positioned with their inner recess sections oriented downward, by the inclined

support section while achieving smooth sliding movement of the caps in the cap pathway with a simple and inexpensive structure.

[0015] It is preferable that the cap pathway be composed of a first cap pathway positioned on an upstream side of the cap direction changing section and a second cap pathway positioned on a downstream side of the cap direction changing section and placed orthogonal to the first cap pathway, that the cap direction changing section include a guide pathway provided in a way of allowing rotational driving for storing the caps, which have moved through the first cap pathway, in an inclined state through a first opening on one end side and a guide plate for preventing the caps from dropping from a second opening on the other end side of the guide pathway, and that when the cap direction changing section is rotated so as to orient the second opening of the guide pathway obliquely downward, the guide plate be operated to connect the second opening and the second cap pathway for allowing movement of the caps, because the direction change for orienting all the inner recess sections of the caps in the same direction can be achieved by a simple and inexpensive structure.

[0016] It is to be noted that the medicine containers include all the containers capable of storing medicine such as medicine in vial bottles and having upper openings

closed by caps, the containers being formed from various materials such as glass and synthetic resin.

[0017] Moreover, the caps include all the caps mounted on the upper openings of the medicine containers through pressing and/or rotation so as to be able to close the upper openings.

[0018] According to the present invention, simply stirring the caps stored in the cap container through driving of the cap stirring member enables the caps to be moved to the cap pathway through the clearance to be aligned, by which smooth feeding of the caps can be achieved regardless of the simple and inexpensive structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 is a front view showing a tablet storing and dispensing apparatus according to the present invention;

FIG. 2 is a front view showing the inside of the tablet storing and dispensing apparatus in FIG. 1;

FIG. 3 is a cross sectional view taken along a line III-III in FIG. 2;

FIG. 4 is a cross sectional view taken along a line IV-IV in FIG. 2;

FIG. 5 is a cross sectional view taken along a line V-V in FIG. 2;

FIG. 6 is a block diagram showing control by a control section;

FIG. 7 is a front cross sectional view showing a cap feeding section;

FIG. 8 is a side view showing the cap feeding section;

FIG. 9 is a plan view showing the cap feeding section;

FIG. 10 is a fragmentary enlarged cross sectional view showing a cap direction changing section in FIG. 7;

FIG. 11 is a view showing the cap direction changing section rotated counterclockwise from a standby position in FIG. 10;

FIG. 12 is a view showing the cap direction changing section rotated clockwise from the standby position in FIG. 10;

FIG. 13(a) is a view showing a cap fed to a feeding tray, FIG. 13(b) is a view showing the feeding tray forwarded from the state shown in FIG. 13(a), and FIG. 13(c) is a view showing the feeding tray retreated from the state shown in FIG. 13(b);

FIG. 14 is a front view showing a capping section;

FIG. 15 is a side view showing the capping section;

FIG. 16(a) is a plan view and a front view showing the capping section, FIG. 16(b) is a front view showing a vial bottle before being lifted up, FIG. 16(c) is a front view showing the vial bottle immediately after the start of lifting up, and FIG. 16(d) is a front view showing the vial bottle after a cap is mounted;

FIG. 17(a) is a plan view showing a container retaining section before retaining a vial bottle, and FIG. 17(b) is a plan view showing the container retaining section after retaining the vial bottle;

FIG. 18 is a flowchart showing cap feeding control;

FIG. 19 is a flowchart showing vial bottle feeding control;

FIG. 20 is a flowchart showing cap closing control;

FIG. 21 is a flowchart showing another cap closing control;

FIG. 22 is a flowchart showing another cap closing control;

FIG. 23 is a flowchart showing another cap closing control, and

FIG. 24 is a flowchart showing vial bottle delivery control.

Reference Numerals:

[0020] 1 tablet storing and dispensing apparatus

2 cap

2a inner recess section

3 vial bottle

10 main body

20 operation display panel

30a output port

30b output port

30c output port

40 auxiliary tablet feeding section

50 auxiliary cap storing section

60a, 60b, 60c, 60d, 60e door

100 vial bottle feeding section

150 first transfer robot

200 labeling section

250 second transfer robot

300 tablet feeding section

350 third transfer robot

400 image pickup section

450 fourth transfer robot

500 cap feeding section

501 cap container

502a, 502b cap stirring member

503 cap pathway

504 first inclined surface

505 second inclined surface

506 vertical surface

507 lower inclined surface

508 slit

509 rotating shaft

510 stirring section

511a, 511b driven gear

512 motor

512a drive gear

513 direction changing section

514 first cap pathway

515 second cap pathway

516 inclined section

517 third inclined surface

518 guide surface

519 gap section

520 alignment pathway

521 cap stopping section

521a motor

522 cap detecting section

523 stop recess section

524 chute rails

525 removed section

526 pusher

526a link

527 first cap sensor

528 extruding section

529 rotating plate

530 support

530a spindle

530b roller

531 cylindrical body

531a spindle

532 cutaway section

532a recess section

532b spring

532c shank

533 guide plate

534 guide pathway

535 cap standby section

536 actuator

536a rod

537 feeding tray

538 roller

539 mounting tray

539a inclined section

540 first rod

541 second rod

542 link

542a spindle

542b spring

542c protrusion

550 guide piece

550a inclined section

543 second cap sensor

600 capping section

601 retaining member

602 container lifting member

604 cap retaining section

604a actuator

604b motor

605 container retaining section

606 sliding member

607 pressing section

608 engagement piece

609 container retaining arm

609a spindle

610 container retaining rollers

611 lifting motor

612 pinion

613 rack

614 lifting tray

615 first sensor

616 second sensor

617 third sensor

700 saving section

800 control section

900 host computer

DETAILED DESCRIPTION OF THE INVENTION

[0021] FIG. 1 is a front view showing a tablet storing and dispensing apparatus 1 according to the present invention, FIG. 2 is a front view showing the inside thereof, FIG. 3 is a cross sectional view taken along a line III-III in FIG. 2, FIG. 4 is a cross sectional view taken along a line IV-IV, and FIG. 5 is a cross sectional view taken along a line V-V.

[0022] 1. Overall Layout

The overall layout of the tablet storing and dispensing apparatus 1 will now be described. As shown in FIG. 1, an operation display panel 20 for displaying information necessary for operation of the tablet storing and dispensing apparatus 1 is provided in an upper front central section of a main body 10. Three vial bottle output ports 30a, 30b, 30c are provided on the lower right side of the operation display panel 20, while an auxiliary tablet feeding section 40 (40a, 40b) is provided on the lower left side, and an auxiliary cap storing section 50 is provided below the auxiliary tablet feeding section 40 (40a,

40b). The auxiliary tablet feeding section 40 stores two kinds of pyrazolone medicine so as to feed the tablets based on prescription data. The auxiliary cap storing section 50 randomly stores a number of caps 2 so that the caps 2 can manually be taken out if necessary. A door 60a for supplementing vial bottles 3 is provided on the upper right side of the front of the tablet storing and dispensing apparatus 1, while a door 60b for replacing and supplementing tablets is provided on the left side, and doors 60c, 60d, 60e for maintenance are also provided on the lower side.

[0023] Inside the tablet storing and dispensing apparatus 1, there are provided, as shown in FIG. 2, FIG. 3 and FIG. 4, a vial bottle feeding section 100, a labeling section 200, a tablet feeding section 300, an image pickup section 400, a cap feeding section 500, a capping section 600 and a saving section 700. As shown in FIG. 2, the vial bottle feeding section 100 is provided on the right front side of the main body 10 for storing a number of vial bottles 3 by size and feeding the vial bottles 3 appropriate for housing the tablets according to the prescription data, one by one. The labeling section 200 is provided in the lower front center of the main body 10 for applying labels with prescription data printed thereon onto the vial bottles 3 fed from vial bottle feeding section 100.

The tablet feeding section 300 is provided on the left side of the main body 10 for storing a number of tablets (non-pyrazolone) by kind and feeding the tablets according to the prescription data. As shown in FIG. 4, the image pickup section 400 is provided on the central rear surface side of the main body 10 for picking up images of the vial bottles 3 from the upper side so as to inspect the tablets contained in the vial bottles 3. As shown in FIG. 3, the cap feeding section 500 is provided on the right side of the main body 10 and in the rear of the vial bottle feeding section 100 for storing caps 2 for closing the vial bottles 3 and feeding the caps 2 one by one. The capping section 600 is provided on the central rear surface side of the main body 10 for plugging (closing) the vial bottles 3, which have been filled with the tablets, with the caps 2 fed from the cap feeding section 500. As shown in FIG. 5, the saving section 700 saves the vial bottles 3 filled with the tablets and plugged with the caps 2 to permit operators to take out the vial bottles 3 from the output ports 30a, 30b, 30c.

[0024] As shown in FIG. 2, the tablet storing and dispensing apparatus 1 is further equipped with a first transfer robot 150, a second transfer robot 250, a third transfer robot 350 and a fourth transfer robot 450. The first transfer robot 150, which is provided below the vial

bottle feeding section 100, is capable of retaining the vial bottles 3 fed from the vial bottle feeding section 100, horizontally transferring the vial bottles 3 from the vial bottle feeding section 100 to the labeling section 200 in the leftward direction of the main body and transferring the vial bottles 3 upward from the labeling section 200 to the second transfer robot 250 or to the third transfer robot 350. The second transfer robot 250, which is provided inside the tablet feeding section 300, is capable of retaining the vial bottles 3 delivered from the first transfer robot 150, transferring the vial bottles 3 to each feeding port in the tablet feeding section 300, and transferring the vial bottles 3 from the feeding ports to the third transfer robot 350. The third transfer robot 350, which is provided above the first transfer robot 150 in the main body 10, is capable of delivering the vial bottles 3 delivered from the first transfer robot 150 or the second transfer robot 250 to the capping section 600 and the fourth transfer robot 450. The fourth transfer robot 450, which is provided above the third transfer robot 350, is capable of transferring the vial bottles 3 delivered from the third transfer robot 350 to the saving section 700 in the upward direction.

[0025] Moreover, as shown in FIG. 4, the tablet storing and dispensing apparatus 1 includes a control section 800

on the right side of the main case 10. As shown in the block diagram in FIG. 6, the control section 800 is composed of a personal computer (PC) 801 with a device control application installed thereinto and an equipment control device 802 made of a microcomputer and the like. The PC 801 is connected to a host computer 900 provided in hospitals and pharmacies for receiving inputs of data such as prescription data. The PC 801 is also connected to the operation display panel 20 for outputting display information necessary for operation of the tablet storing and dispensing apparatus 1 and receiving inputs of operation information from a touch panel on the operation display panel 20. The PC 801 is further connected to a digital camera in the image pickup section 400. The equipment control device 802 is connected to sensors and drive units of the vial bottle feeding section 100, the labeling section 200, the tablet feeding section 300, the cap feeding section 500, the capping section 600 and the saving section 700 for executing drive control of each section and is further connected to sensors and drive units of the first transfer robot 150, the second transfer robot 250, the third transfer robot 350 and the fourth transfer robot 450 for executing drive control of each section.

[0026] 2. Structure of Cap Feeding Section 500

As shown in FIG. 7 to FIG. 9, the cap feeding section 500

is composed of a cap container 501 for storing a plurality of the caps 2, cap stirring members (cap stirring devices) 502a, 502b for stirring the caps 2 inside the cap container 501, and a cap pathway 503 for the caps 2 in the cap container 501 to move. It is to be noted that the vial bottles 3 and the caps 2 used herein are provided with a locking mechanism in order to prevent the vial bottles 3 and the caps 2 from being easily uncapped by children. More specifically, an engagement section (not shown) protruding to the outer circumferential side is formed on the upper opening of the vial bottle 3. Moreover, an engagement receiving section (not shown) for engaging and disengaging the engagement section is formed on the cap 2, and an elastic protruding section (not shown) is mounted as an independent component on an inner recess section 2a. Consequently, once the cap 2 is mounted on the vial bottle 3, the cap 2 cannot be removed from the vial bottle 3 unless the cap 2 is pressed toward the vial bottle 3 against an elastic force of the elastic protruding section of the cap 2 before the cap 2 is rotated so as to release the engagement section from the engagement receiving section.

[0027] The cap container 501 is composed of two inclined surfaces (first inclined surface 504 and a second inclined surface 505) each having a bottom surface in a generally V

shape in cross section. A vertical surface 506 and a lower inclined surface 507 continuing to the first inclined surface 504 as well as the second inclined surface 505 have slits 508 each formed at specified intervals in the width direction.

[0028] A cap stirring member 502 is formed by protruding a plurality of stirring sections 510 in the radial direction from a rotating shaft 509. Each of the stirring sections 510 is made of a wire rod, which is placed in a spiral manner around the rotating shaft 509 with its top end section being gradually curved toward the downstream side of the rotating direction. The cap stirring member 502 is placed at two locations so that the rotating shafts 509 are parallel to each other. In one cap stirring member 502a, the stirring sections 510 protrude into the cap container 501 through the respective slits 508 formed on the first inclined surface 504, while in the other cap stirring member 502b, the stirring sections 510 protrude through the slits 508 formed on the second inclined surface 505. The stirring sections 510 of the cap stirring members 502a, 502b are placed in the state of being axially displaced so as to overlap with each other. Driven gears 511a, 511b gearing with each other are respectively mounted on one end portions of the rotating shaft 509 of the cap stirring member 502a, 502b. The driven gears 511a, 511b

gear with a drive gear 512a rotated by the driving of a motor 512, and both of the cap stirring members 502a, 502b rotate in synchronization with this rotation.

[0029] The cap pathway 503 is composed of a first cap pathway 514 and a second cap pathway 515 placed so as to be orthogonal to each other via a cap direction changing section (cap direction changing device) 513.

[0030] The first cap pathway 514 is composed of a space formed by an inclined section 516 extending from the inner side surface of the cap container 501 and the second inclined surface 505. The inclined section 516 is composed of a third inclined surface 517 which gradually comes closer to the second inclined surface 505 from the inner side surface while staying parallel to the second inclined surface 505 and a guide surface 518 parallel to the second inclined surface 505. Between the guide surface 518 and the second inclined surface 505, a clearance (gap section 519), which allows only one cap 2 to pass in the thickness direction, is formed. Consequently, when the cap stirring member 502 is driven to stir the caps 2 in the cap container 501, the caps 2 sequentially go into the first cap pathway 514 one by one through the gap section 519. Moreover, the caps 2 which have gone into the first cap pathway 514 are aligned in an alignment pathway 520 defined by the guide surface 518, the second inclined surface 505

and both inner side surfaces.

[0031] Along the first cap pathway 514, a cap stopping section 521 and a cap detecting section 522 are provided.

[0032] As shown in FIG. 8 and FIG. 9, the cap stopping section (cap stopping device) 521 is a disc having a stop recess section 523 formed by cutting off a part of the disc. The cap stopping section 521 can temporarily stop the caps 2 moving on the cap pathway 503 by their own weight, retain the caps 2 in the stop recess section 523 by rotating them by driving of a motor 521a and sequentially moving them downward one by one.

[0033] The cap detecting section 522 is composed of a pusher 526 and a first cap sensor 527 provided in a removed section 525 formed by removing a part of chute rails 524 formed on the bottom surface of the cap pathway 503 at a specified interval. The interval of the chute rails 524 is 2/3 of a maximum inner diameter of the inner recess section 2a of the cap 2. Consequently, the cap 2 sliding on the chute rails 524 has the inner recess section 2a facing down, as a result of which a part of the cap 2 falls in the removed section 525 and stops in the inclined state supported by upper notch ends and lower notch ends of the chute rails 524.

[0034] As shown in FIG. 10, the pusher 526 is composed of an extruding section 528 to which an end portion of a

link 526a is rotatably connected and a rotating plate 529 to which the other end portion of the link 526a is rotatably connected. When the rotating plate 529 is rotated by driving of a motor (not shown), the extruding section 528 reciprocates via the link 526a. By the extruding section 528 moving to a protruding position, a part of the cap 2 maintained in the inclined state by the upper notch ends and the lower notch ends of the chute rails 524 is pushed onward to be parallel to the first cap pathway 514 and thereby transferred to the cap direction changing section 513.

[0035] Moreover, the first cap sensor 527 detects the inclined state of the cap 2 supported by the removed section 525 of the chute rails 524, and a detection signal thereby is used for drive control of the pusher 526 and the later-described cap direction changing section 513.

[0036] As shown in FIG. 10, the cap direction changing section 513 is made of a cylindrical body 531 provided rotatably around a spindle 531a mounted on a support 530, the cylindrical body 531 having a cutaway section 532 with a semicircle cross section formed on an outer circumferential section of the cylindrical body 531, the cutaway section 532 having a guide plate 533 placed therein. The cylindrical body 531 has a guide pathway 534 formed from the outer circumferential surface to the cutaway

section 532 so that the cap 2, which has passed the cap detecting section 522, can go into the cutaway section 532 (via a first opening 534a). Moreover, the cutaway section 532 has an escape recess section 532a, in which a spring 532b is placed. The spring 532b is made of a plate spring, which is mounted on a shank 532c provided in the escape recess section 532a, and one end section of the spring 532b is fixed onto the bottom surface of the escape recess section 532a while the other end section is fixed to one end section of the guide plate 533. As a result, the guide plate 533 is elastically supported by the spring 532b and is positioned so that a curved section closes one end side (second opening 534b) of the guide pathway 534 in order to prevent the caps 2 from dropping from the guide pathway 534. Moreover, the support 530 is provided with a contact section 530c having a rotatable roller 530b placed at the top end thereof. The contact section 530c comes into contact with one end section of the guide plate 533, thereby elastically deforming the spring 532b and positioning the guide plate 533 so as to connect the guide pathway 534 and the second cap pathway 515.

[0037] Moreover, the cap direction changing section 513 is positioned at a standby position shown in FIG. 10 in an initial state where the guide pathway 534 connects to the first cap pathway 514. When the motor 512 is driven in the

forward direction to rotate the cylindrical body 531 around the spindle 531a counterclockwise (shown by an arrow in FIG. 12), the connected destination of the guide pathway 534 can be changed from the first cap pathway 514 to the second cap pathway 515 as shown in FIG. 12. In the case where the inner recess section 2a of the cap 2 is positioned downward, the changeover is used for moving the cap 2 from the first cap pathway 514 to the second cap pathway 515 while maintaining the state. When the motor 512 is rotated in the backward direction to rotate the cylindrical body 531 around the spindle 531a clockwise (shown by an arrow in FIG. 11), the inclination of the guide pathway 534 conforms to that of the second cap pathway 515 as shown in FIG. 11. Moreover, a contact section 530c comes into contact with one end section of the guide plate 533, by which the other end side of the guide plate 533 connects the guide pathway 534 and the second cap pathway 515. Consequently, the cap 2 in the guide pathway 534 can move to the second cap pathway 515. In the case where the inner recess section 2a of the cap 2 moving through the first cap pathway 514 is positioned upward, the changeover is used for changing the direction so as to position the inner recess section 2a downward and then moving the cap 2 to the second cap pathway 515.

[0038] As shown in FIG. 13, the second cap pathway 515

has a cap standby section 535 on its lower end portion. The cap standby section 535 includes an actuator 536 for temporarily stopping the cap 2 and a feeding tray 537 which can reciprocate in the horizontal direction. The actuator 536 energizes and demagnetizes a solenoid for protruding and withdrawing a rod 536a in the second cap pathway 515 so as to approve and reject the feeding of the cap 2 to the feeding tray 537.

[0039] The outer circumferential section of the tray 537 has four notches evenly provided for avoiding the interference with an engagement piece 608 when the mounted cap 2 is retained by a later-described cap retaining section 604. Moreover, the feeding tray 537, which is mounted on a roller 538 and a mounting tray 539, reciprocates in the horizontal direction by rotational driving of the roller 538. The top end of the mounting tray 539 has an inclined section 539a gradually extending upward. Moreover, the feeding tray 537 includes a first rod 540 and a second rod 541 protruding from and withdrawing to the upper surface. The first rod 540 is provided on the other end section of a link 542 which rotates around a spindle 542a placed on one end portion. The link 542 is biased to be in the horizontal state by a spring 542b. In this state, the first rod 540 protrudes upward from the feeding tray 537. The second rod 541

protrudes upward from the feeding tray 537 upon being pressed by the mounting tray 539 and withdraws into the feeding tray 537 upon distancing from the mounting tray 539.

[0040] In the case where the feeding tray 537 is at a standby position continuing to the second cap pathway 515, a protrusion 542c formed in the middle section of the link 542 comes into contact with an inclined section 550a of a guide piece 550, by which the link 542 rotates against the biasing force of the spring 542b so that the second rod 541 retreats from the upper surface of the feeding tray 537. Therefore, driving the actuator 536 to retreat the rod 536a makes it possible to feed the cap 2 from the second cap pathway 515 to the feeding tray 537. Once the feeding tray 537 is advanced in the state where the cap 2 has been fed to the feeding tray 537, the protrusion 542c of the link 542 moves along the inclined section 539a of the mounting tray 539, so that the first rod 540 gradually protrudes upward from the feeding tray 537. Consequently, the cap 2 is pressed by the first rod 540 and advances together with the feeding tray 537. The cap 2 mounted on the advanced feeding tray 537 is transferred by the later-described cap retaining section 604, and the upper opening of the vial bottle 3 is closed.

[0041] It is to be noted that whether or not the cap 2 is fed onto the feeding tray 537 is detected by a second

cap sensor 543.

[0042] 3. Operation of Cap Feeding Section 500

The operation of the cap feeding section 500 will now be described.

[0043] (Cap Feeding Control)

As shown in FIG. 18, once the kind and amount of medicine contained in the vial bottle 3 are determined based on the inputted prescription data (step S501), a vial bottle 3 of an appropriate size is selected based on the kind and the amount. Thus, driving of the cap feeding section 500 is started.

[0044] First, the cap stirring member 502 is driven to stir the caps 2 in the cap container 501 (step S502). The cap stirring member 502 is provided in two locations, and their stirring sections 510, each made of a wire rod, are moved from the lower side to the upper side by the first inclined surface 504 and the second inclined surface 505 constituting the bottom surface of the cap container 501. Moreover, the stirring sections 510 are placed in a spiral way for stirring the caps 2 so that the caps 2 are moved to the inclined section 516. Accordingly, after the caps 2 are temporarily moved away from the vicinity of the gap section 519, the caps 2 are stirred by the stirring sections 510 so that they advance toward the gap section 519. Therefore, although only one cap 2 can pass through

the clearance of the gap section 519, the caps 2 can smoothly go into the first cap pathway 514.

[0045] The caps 2, which have gone into the first cap pathway 514, are aligned by passing the alignment pathway 520 and stopping at the cap stopping section 521. At this point, whether or not the cap 2 is detected is determined by a sensor (not shown) provided in the cap stopping section 521 (step S503). If the cap 2 is detected, then the cap stopping section 521 is rotated (step S504) so that only one cap 2 is retained by the stop recess section 523, and the cap 2 is moved to the further downstream side.

[0046] The caps 2 aligned in the first cap pathway 514 include both the caps with the inner recess section 2a positioned downward and the caps with the inner recess section 2a positioned upward. The caps with the inner recess section 2a positioned downward stop at the removed section 525 in an inclined state gained by the upper notch ends of the chute rails 524 engaging with the inner recess section 2a. Therefore, a detection signal in the first cap sensor 527 is switched to an on state. The caps with the inner recess section 2a positioned upward slide on the chute rails 524 in the first cap pathway 514 and directly into the guide pathway 534 in the cap direction changing section 513 without stopping at the removed section 525. Therefore, the detection signal in the first cap sensor 527

maintains an off state.

[0047] At this point, it is determined whether or not an on signal is outputted from the first cap sensor 527 (step S505). If the on signal is outputted, the pusher 526 is driven in response to the on signal (step S506). As a result, the cap 2 is released from the stopped state in the removed section 525 and restarts movement in the first cap pathway 514 so as to go into the guide pathway 534 in the cap direction changing section 513 as shown in FIG. 10. In the cap direction changing section 513, the motor 512 is driven in the forward direction in response to the on signal by the first cap sensor 527 (step S507) to rotate around the spindle 531a counterclockwise, so that the guide pathway 534 is positioned on the same straight line with the second cap pathway 515 as shown in FIG. 12. This makes the cap 2 in the guide pathway 534 move to the second cap pathway 515 while maintaining the state of the inner recess section 2a positioned downward.

[0048] The caps 2 with the inner recess section 2a positioned upward directly go, as shown in FIG. 10, into the guide pathway 534 in the cap direction changing section 513, where the motor 512 is driven in the backward direction in response to the off signal by the first cap sensor 527 (step S508) so as to rotate the cylindrical body 531 around the spindle 531a clockwise (shown by an arrow in

FIG. 11). This rotation positions the guide pathway 534 on the same straight line with the second cap pathway 515 via the guide plate 533 and changes the direction of the cap 2 so as to position the inner recess section 2a downward. Moreover, in the guide plate 533, during rotation of the cap direction changing section 513, a curved section of the guide plate 533 closes the guide pathway 534 by the biasing force of the spring 532b. With the one end section of the guide plate 533 being pressed by the contact section 530c, the spring 532b is elastically deformed so that the other end side is positioned on the same straight line connecting the guide pathway 534 and the second cap pathway 515. Therefore, the cap 2 in the guide pathway 534 moves to the second cap pathway 515 only after the cap direction changing section 513 rotates to a dispensing position shown in FIG. 11.

[0049] The cap 2 moving to the second cap pathway 515 slides and is temporarily stopped at a standby position by the rod 536a as shown in FIG. 13(a). When the cap 2 has its turn, the rod 536a is retreated from the second cap pathway 515 so that the cap 2 is moved to the feeding tray 537. In this case, since the feeding tray 537 is positioned on the mounting tray 539 with the second rod 541 protruding on the top end side, the cap 2 keeps on moving till it comes into contact with the second rod 541. Once

the cap 2 comes into contact with the second rod 541 and is positioned (once a predetermined time elapsed after the retreat of the rod 536a), the feeding tray 537 is advanced. With the advance of the feeding tray 537, the protrusion 542c moves along the inclined section 550a due to the biasing force of the spring 542b, by which the link 542 rotates around the spindle 542a counterclockwise. Consequently, the first rod 540 protrudes from the upper surface of the feeding tray 537 and so the cap 2 advances together with the feeding tray 537.

[0050] 4. Structure of Capping Section 600

The capping section 600 includes a retaining member 601 and a container lifting member (container lifter) 602.

[0051] As shown in FIG. 14 and FIG. 15, the retaining member 601, which is composed of a cap retaining section (cap retaining device) 604 and a container retaining section (container retaining device) 605, is provided on a sliding member (sliding device) 606 movable in the horizontal direction (two orthogonal directions).

[0052] As shown in FIG. 14, the cap retaining section 604 includes a pressing section 607 which ascends and descends by driving of an actuator 604a and which rotates by driving of a motor 604b, and four engagement pieces 608 for retaining the outer circumferential surface of the cap 2. The pressing section 607 has, as shown in FIG. 16(a),

an anti-slip section 607a made of a material having a large coefficient of friction for preventing the slipping of the cap 2 during pressing and rotation of the cap 2. Moreover, the pressing section 607 has a spring 607b for allowing elastic pressing of the cap 2. The engagement pieces 608, which are made of plate springs and the like, are equally placed at four locations around the pressing section 607. The engagement pieces 608 are gradually inclined inward toward their top ends. Moreover, the top end sections of the engagement pieces 608 are curved so as to be widened toward the external diameter, so that the curved sections 608a can elastically retain the outer circumferential surface of the cap 2.

[0053] As shown in FIG. 17, the container retaining section 605 is composed of container retaining arms 609 placed at specified intervals, the container retaining arms 609 each have a pair of container retaining rollers 610, so that these four container retaining rollers 610 support the vial bottle 3. The container retaining arm 609 is provided rotatably around a spindle 609a provided on its curved section, and the container retaining roller 610 is rotatably mounted on its one end section while a spring 609b is engaged with the other end section thereof. By the biasing force of the spring 609b, each pair of the container retaining rollers 610 is biased so as to be

closer to each other.

[0054] The container lifting member 602 is for lifting a lifting tray 614 via a pinion 614 and a rack 613 by driving of a lifting motor 611. As with the pressing section 607, an anti-slip section 614a made of a material having a large coefficient of friction is provided on the upper surface of the lifting tray 614. Moreover, the lifting position of the lifting tray 614 is detected by each of a first sensor 615, a second sensor 616 and a third sensor 617.

[0055] It is to be noted that the vial bottle 3 with medicine fed thereto at the transfer position is transferred by the third transfer robot 350 to the capping section 600. The third transfer robot 350, which has a pair of nip pieces, which can open and close, is slidable in the horizontal direction.

[0056] 5. Operation of Capping Section 600

The operation of the capping section 600 will be described below.

[0057] (Vial Bottle Feeding Control)

As shown in FIG. 19, once a vial bottle 3 with medicine fed thereto at the transfer position is detected (step S601), the third transfer robot 350 is driven to retain the vial bottle 3 (step S602). Then, the vial bottle 3 is moved to a photo shooting position for photo shooting of the medicine in the vial bottle 3 by a medicine image pickup

member (not shown) (step S603), while a photo shooting enabling signal is transmitted (step S604). At this point, the capping section 600 is moved over the cap standby section 535 and the pressing section 607 and the engagement pieces 608 are lowered so that the cap 2 on the feeding tray 537 is retained by the engagement pieces 608. It is also possible to lower the engagement pieces 608 to the level of the feeding tray 537 in advance before the cap 2 is fed onto the feeding tray 537 so that the cap 2 is retained by the engagement pieces 608 from the lateral side.

[0058] Upon completion of the photo shooting and reception of an outputted photo shooting complete signal (step S605), the vial bottle 3 is moved to a capping position where the cap 2 can be mounted on the vial bottle 3 by the cap retaining section 604 and the container lifting member 602 (step S606). At the capping position, the vial bottle 3 is retained by the container retaining section 605 (step S607), while the vial bottle 3 retained by the third transfer robot 350 is released (step S608). The third transfer robot 350 is put in standby on the spot (step S609).

[0059] Upon mounting of the cap 2 on the vial bottle 3 and reception of a cap mounting complete signal under later-described capping control (step S610), the vial bottle 3 is retained again by the third transfer robot 350

(step S611), and is moved to a later-described delivery position (step S612). At the delivery position, the vial bottle 3 is delivered to the fourth robot arm, by which the operation of the third transfer robot 350 (vial bottle feeding control) is finished (step S613).

[0060] (Capping Control)

As shown in FIG. 20, upon reception of the photo shooting complete signal (step S621), the retaining member 601 is driven so that the cap retaining section 604 retains the cap 2 which is ready on the feeding tray 537 of the cap feeding section 500 under the cap feeding control (see FIG. 18) (step S622). More specifically, the cap retaining section 604 is moved over the feeding tray 537, and the actuator 536 is driven to lower the engagement pieces 608. Since the engagement pieces 608 have elasticity, the curved section thereof is widened upon coming into contact with the upper edge section of the cap 2 and thereby comes into tight contact with the outer circumferential surface of the cap 2, by which the cap 2 is retained. In this case, since the feeding tray 537 is formed into a generally crucial shape, it would not interfere with the engagement pieces 608.

[0061] Once the cap 2 is retained, the retaining member 601 is driven again so that the vial bottle 3 transferred into the capping section 600 is retained by the container

retaining section 605 (step S623) as shown in FIG. 16(b). Then, the motor 512 is driven to raise the lifting tray 614 to lift the vial bottle 3 retained by the container retaining section 605 (step S624). In response to a detection signal by the sensor (step S625), the lifting tray 614 is temporarily stopped at the position where the upper opening of the vial bottle 3 comes into contact with the cap 2 as shown in FIG. 16(c). Then, the motor 512 is driven to rotate the cap 2 (step S627) and the lifting tray 614 is again raised as shown in FIG. 16(d) (step S628). After that, in response to a detection signal by the sensor (step S629), the lifting tray 614 is stopped (step S630). Consequently, the engagement section of the vial bottle 3 can be engaged with the engagement receiving section of the cap 2 while the cap 2 is pressed to the upper opening of the vial bottle 3 against the biasing force of the elastic protruding section of the cap 2, resulting in implementation of smooth mounting of the cap 2.

[0062] (Second Capping Control)

It is to be noted that the mounting process of the cap 2 may be as follows. That is, as shown in FIG. 21, upon reception of the photo shooting complete signal (step S641), the vial bottle 3 is retained (step S642), and then the cap 2 is first rotated (step S643). Then, the vial bottle 3 is lifted (step S644) till it reaches a specified position

(step S645), by which the lifting operation is finished (step S646). According to the process, the cap 2 has only to be rotated at the moment when the preparation for lifting the vial bottle 3 is completed, which makes it possible to facilitate control procedures.

[0063] (Third Capping Control)

Moreover, as shown in FIG. 22, upon reception of a photo shooting complete signal (step S651), the cap 2 is rotated (step S652). Then, after the vial bottle 3 is retained (step S653), the vial bottle 3 is lifted (step S654) till it reaches a specified position (step S655), by which the lifting operation is finished (step S656). According to the process, the cap 2 has only to be rotated from the beginning of the mounting operation, which makes it possible to further facilitate the control procedures.

[0064] (Fourth Capping Control)

Moreover, as shown in FIG. 23, upon reception of a photo shooting complete signal (step S661), the vial bottle 3 is retained (step S662) and then the vial bottle 3 is rotated (step S663). Then, the vial bottle 3 is lifted (step S664) till it reaches a specified position (step S665), by which the lifting operation is completed. In this control, however, a mechanism for rotating the vial bottle 3 is necessary in place of the mechanism for rotating the cap 2.

[0065] (Vial Bottle Discharge Control)

Thus, the vial bottle 3 with the cap 2 mounted thereon is transferred to a specified position by the fourth transfer robot 450. The fourth transfer robot 450, which is rotatably provided, has an openable nip plate (not shown) on its top end.

[0066] In the vial bottle discharge control as shown in FIG. 24, once the vial bottle 3 is detected at the transfer position (step S671), the vial bottle 3 is retained by the third transfer robot 350 (step S672), and stock location data on the vial bottle 3 is received (step S673). Then, the third transfer robot 350 is driven to move the vial bottle 3 (step S674), and the third transfer robot 350 is raised or lowered based on the stock location data. Once the vial bottle 3 reaches a target stock height (step S675), an arm is extended (step S676), and when the vial bottle 3 reaches the stock position (step S677), the arm is released to deliver the vial bottle 3 to the fourth transfer robot 450 (step S678). After that, the third transfer robot 350 is moved (returned) to a home position, i.e., the transfer position (step S679).